2021 West Virginia Infrastructure Report

(January 1, 2021 – December 31, 2021)

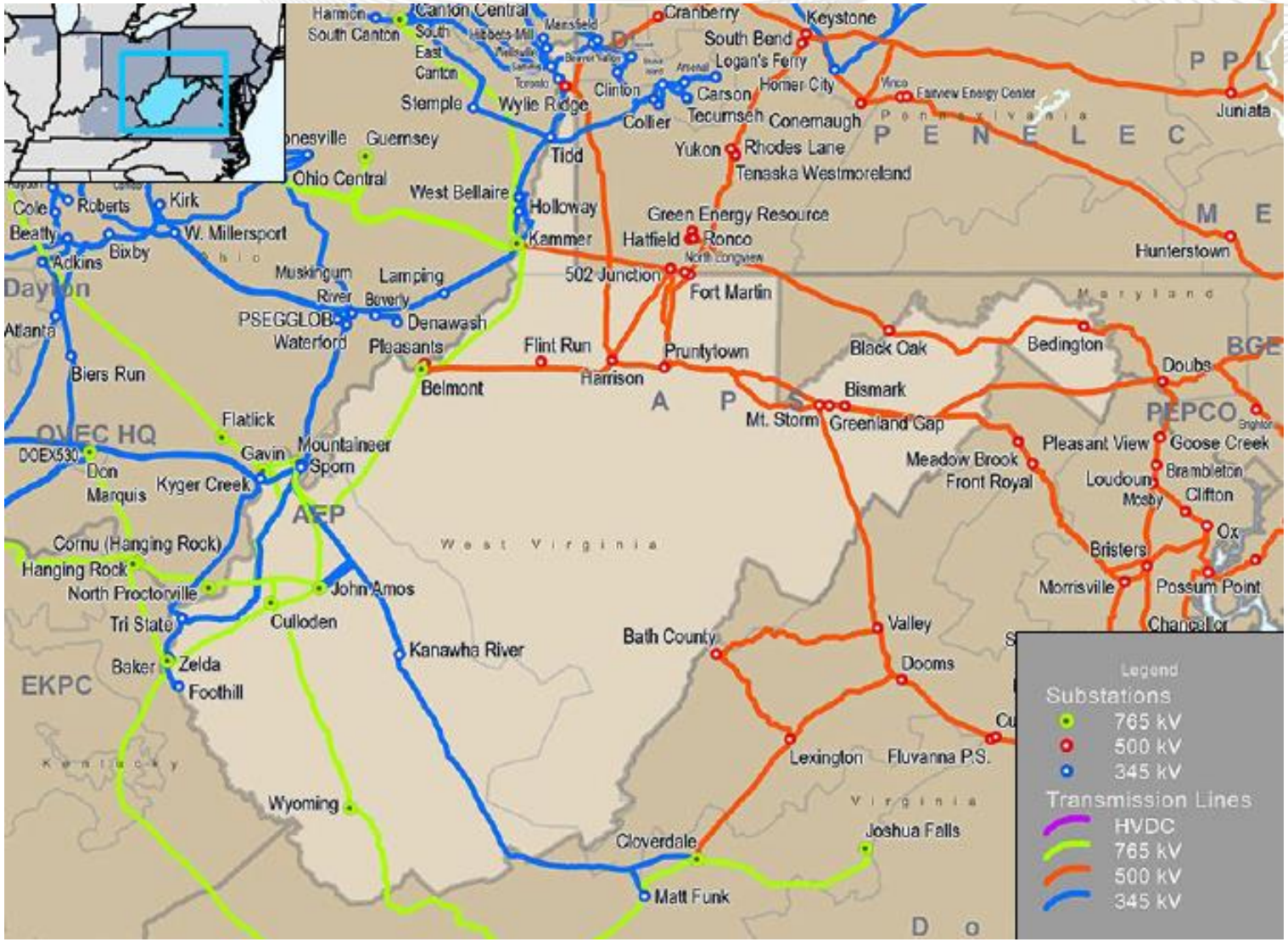
May 2022

Table of Contents

- **Existing Capacity:** Coal represents approximately 88.7 percent of the total installed capacity in the West Virginia service territory while natural gas represents approximately 7.9 percent. Across PJM, natural gas and coal account respectively for 44.2 and 26.6 percent of total installed capacity, respectively.
- **Interconnection Requests:** Solar represents 44.4 percent of new interconnection requests in West Virginia, while natural gas represents approximately 43.2 percent of new requests
- **Deactivations:** A small storage facility was the only generation in West Virginia to give a notification of deactivation in 2021.
- **RTEP 2021:** West Virginia's 2021 RTEP project total represents approximately $211 million in investment.

- **Load Forecast:** West Virginia's summer peak load is projected to increase by 0.1 percent annually over the next ten years, while the winter peak is projected to increase by 0.3 to 0.4 percent depending on the transmission zone.
- **2022/23 Capacity Market:** 6,209 MW in West Virginia cleared in the 2022/23 Base Residual Auction.
- **1/1/21 – 12/31/21 Market Performance:** West Virginia's average hourly LMPs aligned with the PJM average hourly LMP.
- **Emissions:** West Virginia's average CO2 emissions slightly increased in 2021 compared to 2020 levels.

PJM Service Area – West Virginia

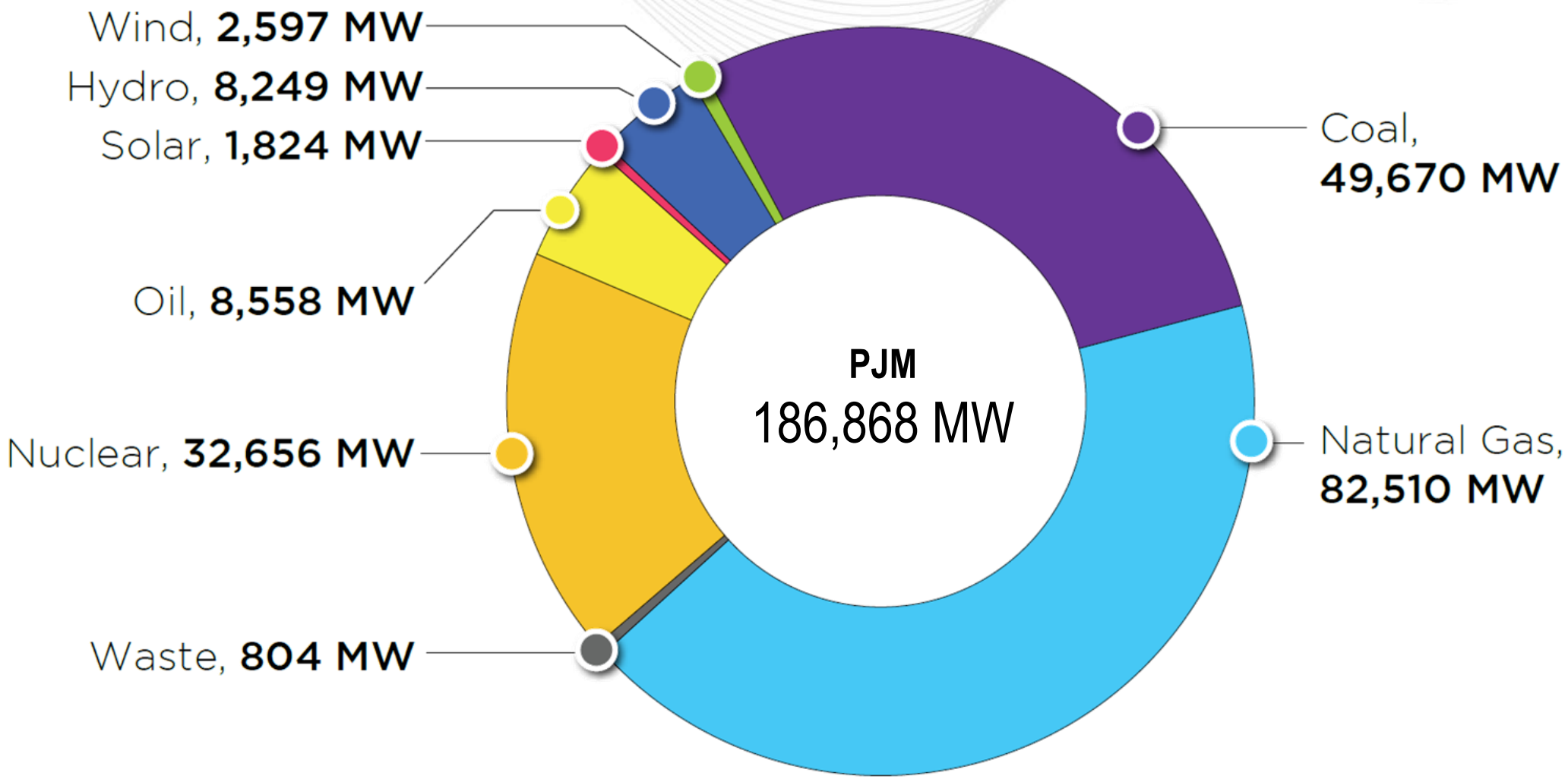


Planning

Generation Portfolio Analysis

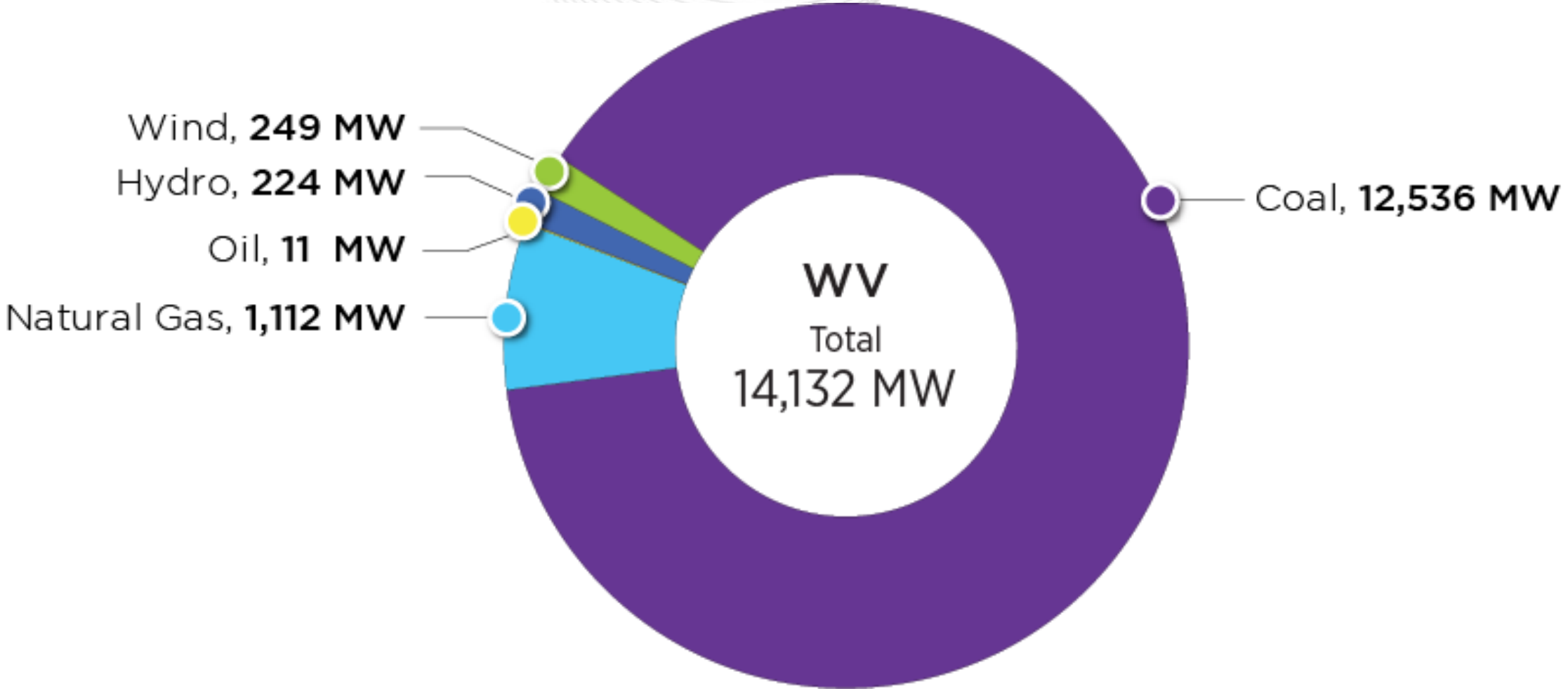
PJM – Existing Installed Capacity

(CIRs – as of Dec. 31, 2021)



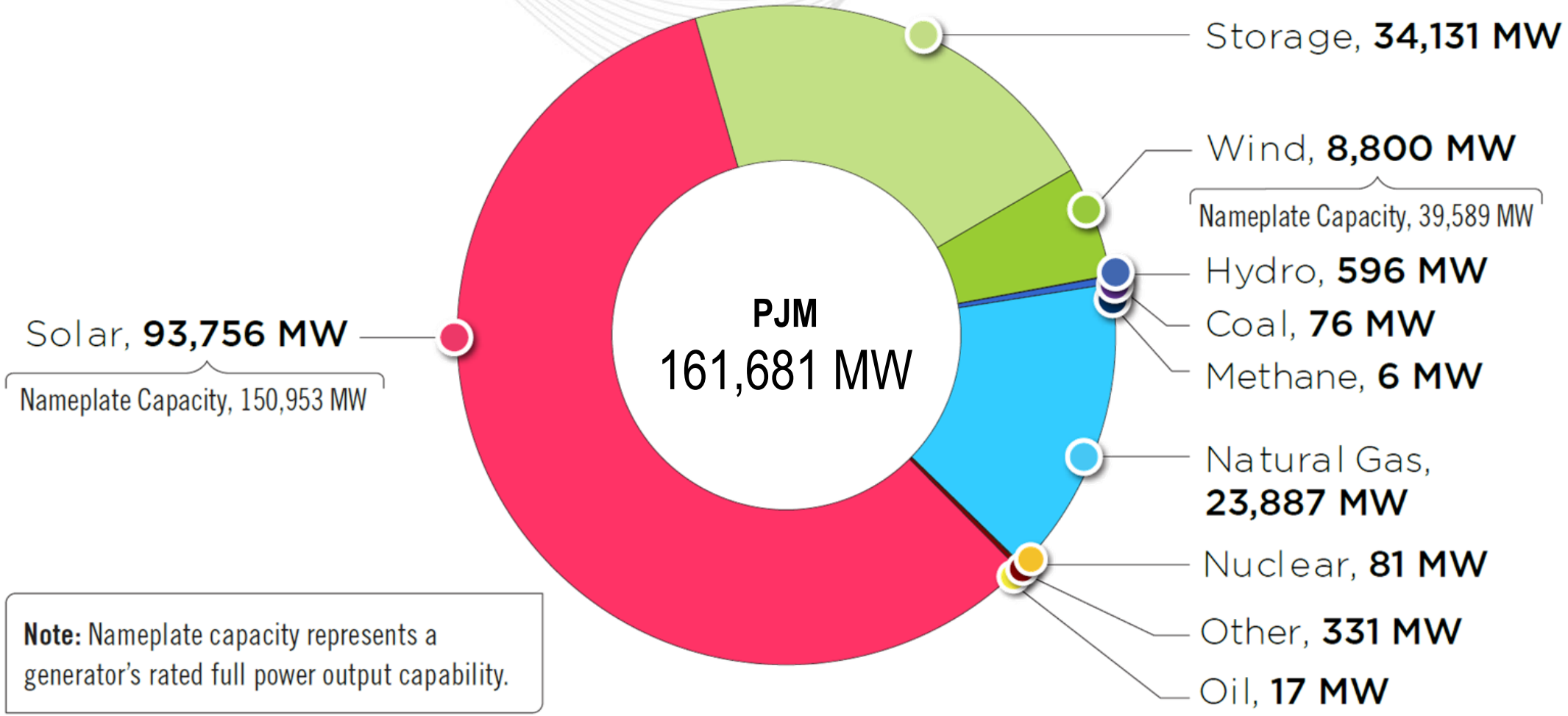
West Virginia – Existing Installed Capacity

(CIRs – as of Dec. 31, 2021)



PJM – Queued Capacity (MW) by Fuel Type

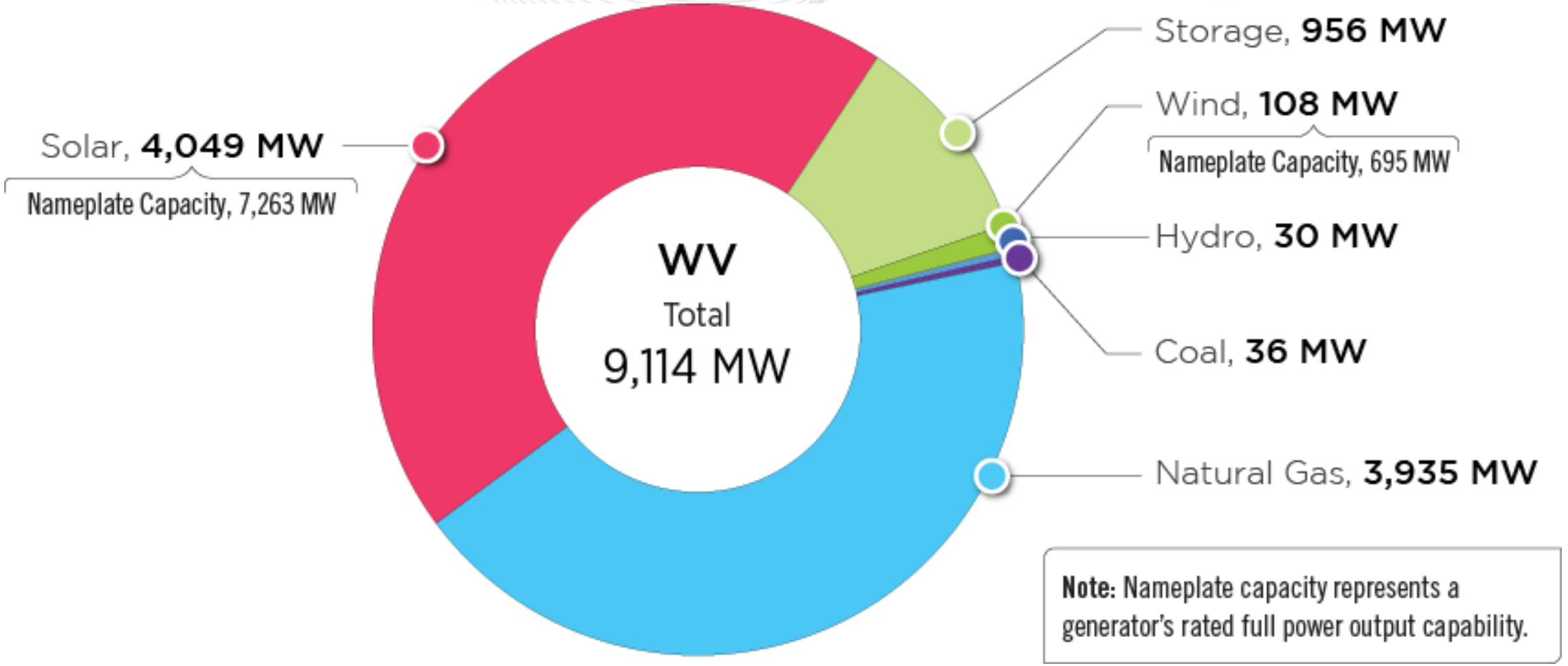
(Requested CIRs – as of Dec. 31, 2021)



Note: Nameplate capacity represents a generator's rated full power output capability.

West Virginia – Queued Capacity (MW) by Fuel Type

(Requested CIRs – as of Dec. 31, 2021)



West Virginia – Historical Interconnection Requests by Fuel Type

(as of Dec. 31, 2021)

		In Queue						Complete					
		Active		Suspended		Under Construction		In Service		Withdrawn		Grand Total	
		Projects	Capacity (MW)	Projects	Capacity (MW)	Projects	Capacity (MW)	Projects	Capacity (MW)	Projects	Capacity (MW)	Projects	Capacity (MW)
Non-Renewable	Coal	0	0.0	0	0.0	1	36.0	10	861.0	7	2,023.0	18	2,920.0
	Natural Gas	3	3,335.0	3	600.0	0	0.0	6	409.7	43	16,140.8	55	20,485.5
	Other	2	0.0	0	0.0	0	0.0	0	0.0	2	66.0	4	66.0
	Storage	13	950.2	1	5.8	1	0.0	1	0.0	4	28.0	20	984.0
Renewable	Biomass	0	0.0	0	0.0	0	0.0	0	0.0	2	48.0	2	48.0
	Hydro	1	30.0	0	0.0	0	0.0	5	59.2	12	208.8	18	298.0
	Methane	0	0.0	0	0.0	0	0.0	3	5.6	3	13.8	6	19.4
	Solar	55	3,993.5	0	0.0	2	55.2	0	0.0	5	74.2	62	4,122.9
	Wind	3	80.6	0	0.0	2	26.8	10	197.5	27	426.5	42	731.5
	Grand Total	**77**	**8,389.4**	**4**	**605.8**	**6**	**118.0**	**35**	**1,533.0**	**105**	**19,029.2**	**227**	**29,675.4**

Note: The ”Under Construction” column includes both “Engineering and Procurement” and “Under Construction” project statuses.

West Virginia – Progression History of Interconnection Requests

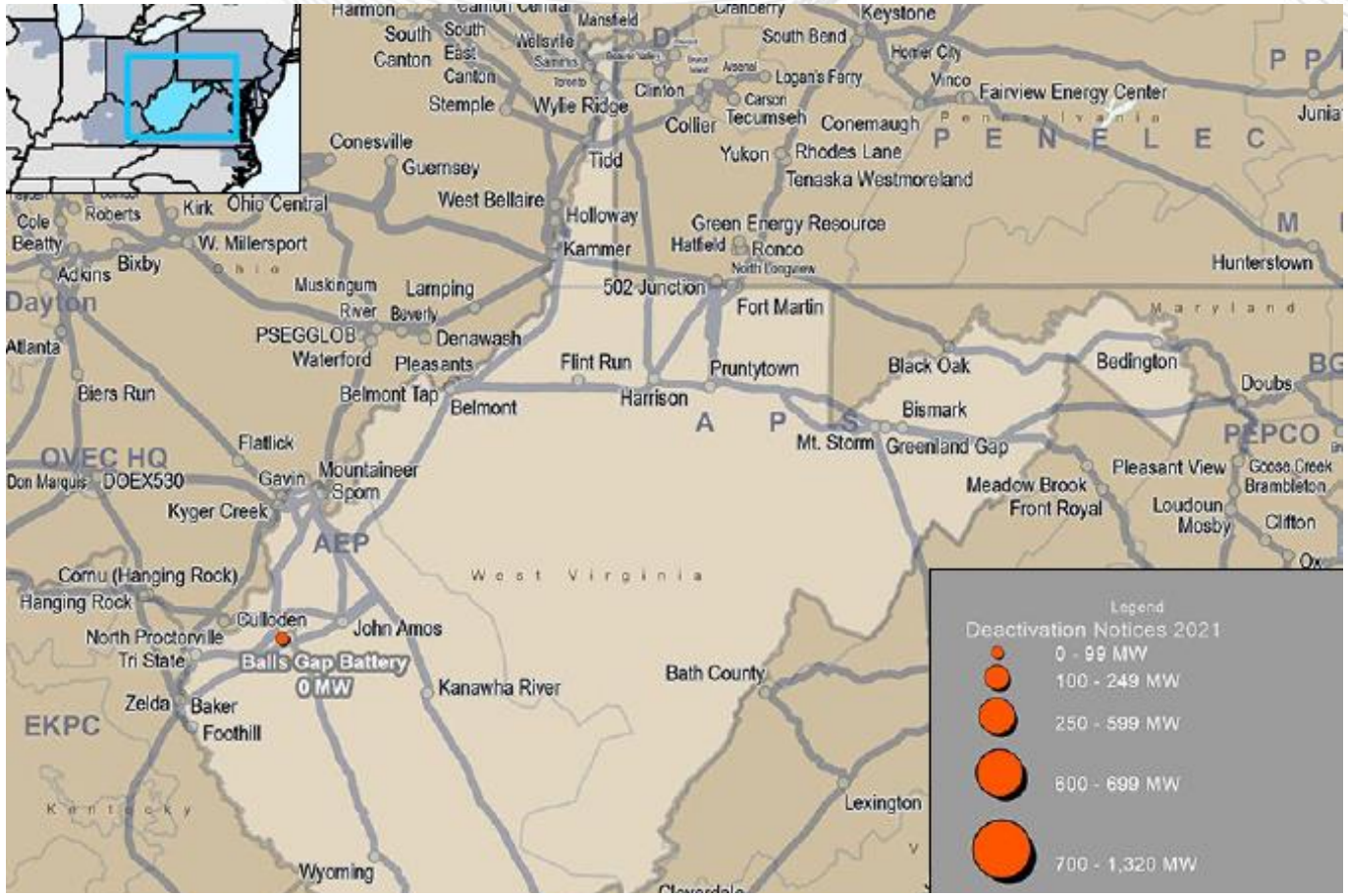
Percentage of planned capacity and projects that have reached commercial operation

7.4%	Requested capacity megawatts
24.7 %	Requested projects

			Capacity	Nameplate
Projects withdrawn after final agreement	12	Interconnection Service Agreements	1,499 MW	1,951 MW
	2	Wholesale Market Participation Agreements	6 MW	11 MW

This graphic shows the final state of generation submitted to the PJM queue that completed the study phase as of Dec. 31, 2021, meaning the generation reached in-service operation, began construction, or was suspended or withdrawn. It does not include projects considered active in the queue as of Dec. 31, 2021.

West Virginia – Generation Deactivation Notifications Received in 2021



Unit	TO Zone	Fuel Type	Request Received to Deactivate	Actual or Projected Deactivation Date	Age (Years)	Capacity (MW)
Balls Gap Battery Facility	AEP	Storage	1/21/2021	4/22/2021	12	0

Planning

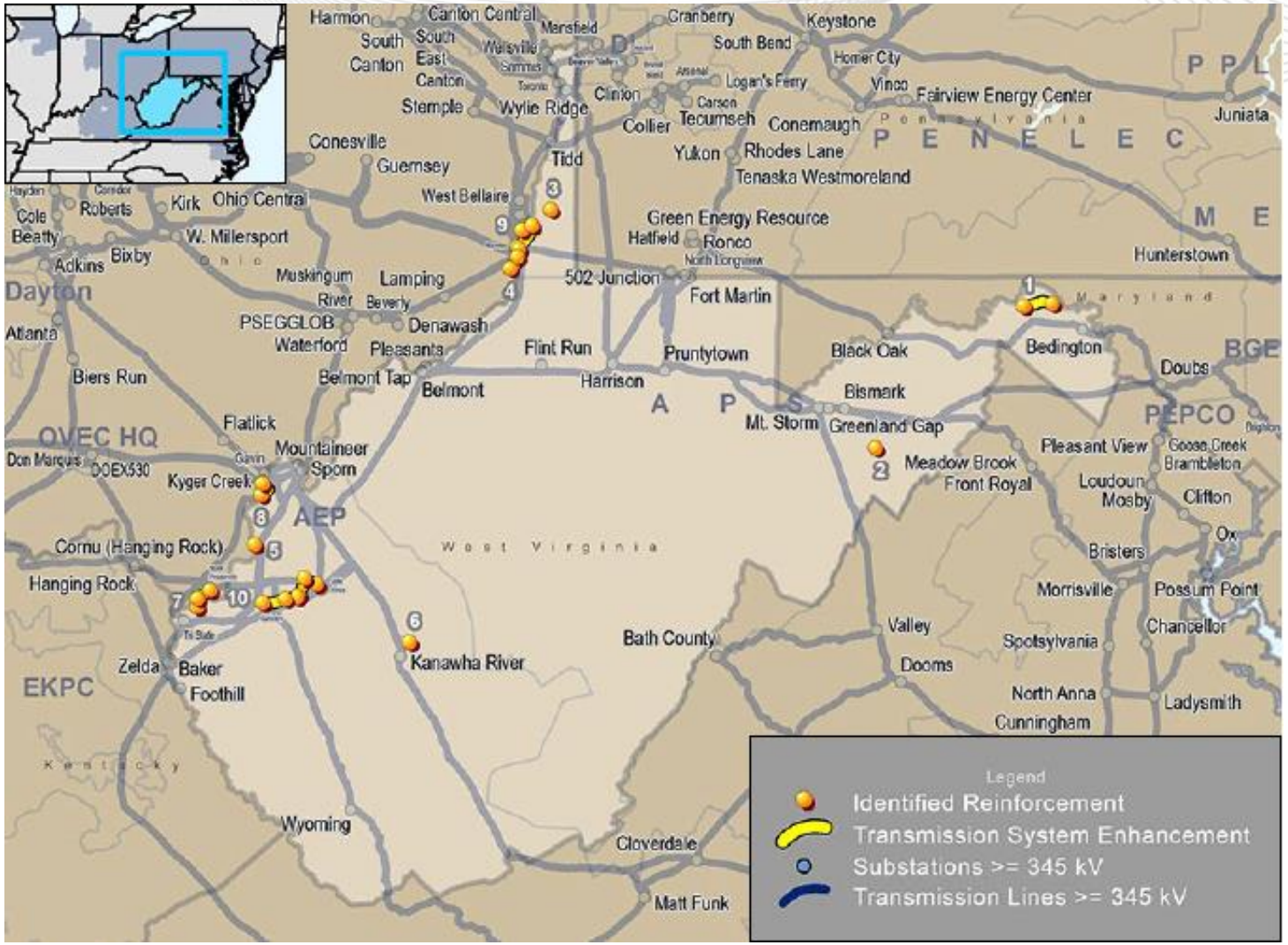
Transmission Infrastructure Analysis

Please note that PJM is now listing all transmission projects in its Annual RTEP and state infrastructure reports, beginning with this year's 2021 Annual RTEP. In previous years only projects above a $10 million threshold were listed in the Annual RTEP Report and projects above a $5 million threshold were listed in the state infrastructure reports. This change may increase the amount of projects listed in these reports going forward now that smaller projects below the previous $5 million cutoff are being included.

The complete list of all RTEP projects in PJM, including those from prior years, can be found at the "RTEP Upgrades & Status – Transmission Construction Status" page on pjm.com.

https://www.pjm.com/planning/project-construction

West Virginia – RTEP Baseline Projects



Note: Baseline upgrades are those that resolve a system reliability criteria violation.

West Virginia – RTEP Baseline Projects

Map ID	Project	Description	Required In-Service Date	Project Cost ($M)	TO Zone	TEAC Date
1	b3240	Upgrade Cherry Run and Morgan terminals to make the transmission line the	6/1/2024	$0.23	APS	11/20/2020
2	b3241	Install 138 kV, 36 MVAR capacitor and a 5 uF reactor protected by a 138 kV capacitor switcher. Install a breaker on the 138 kV junction terminal. Install a 138 kV, 3.5 uF reactor on the existing Hardy 138 kV capacitor.	6/1/2025	$2.85		
3	b3255	Upgrade 795 AAC risers at Sand Hill 138 kV station toward Cricket Switch with 1272 AAC.		$0.04	AEP	
4	b3275.1	Rebuild Kammer station-Cresaps switch 69 kV, ~0.5 miles.		$4.60		12/1/2020
	b3275.2	Rebuild Cresaps switch-McElroy station 69 kV, ~0.67 miles.				
	b3275.3	Replace a single span of 4/0 ACSR from Moundsville-Natrium str 93L to Carbon Tap switch 69 kV located between Colombia Carbon and Conner Run stations. Remainder of line is 336 ACSR.				
	b3275.4	Rebuild from Colombia Carbon to Columbia Carbon Tap str 93N 69 kV, ~0.72 miles. The remainder of the line between Colombia Carbon Tap structure 93N and Natrium station is 336 ACSR and will remain.				
	b3275.5	Replace the Cresaps 69 kV three-way phase-over-phase switch and structure with a new 1200A three-way switch and steel pole.				
	b3275.6	Replace 477 MCM Alum bus and risers at McElroy 69 kV station.				
	b3275.7	Replace Natrium 138 kV bus existing between CB-BT1 and along the 138 kV main bus No. 1 dropping to CBH1 from the 500 MCM conductors to a 1272 KCM AAC conductor. Replace the dead-end clamp and strain insulators.				
5	b3279	Install a new 138 kV, 21.6 MVAR cap bank and circuit switcher at Apple Grove station.		$1.00		2/17/2021
6	b3280	Rebuild the existing Cabin Creek-Kelly Creek 46 kV line (to structure 366-44), ~4.4 miles. This section is double circuit with the existing Cabin Creek-London 46 kV line, so a double circuit rebuild would be required.		$17.90		1/15/2021

West Virginia – RTEP Baseline Projects

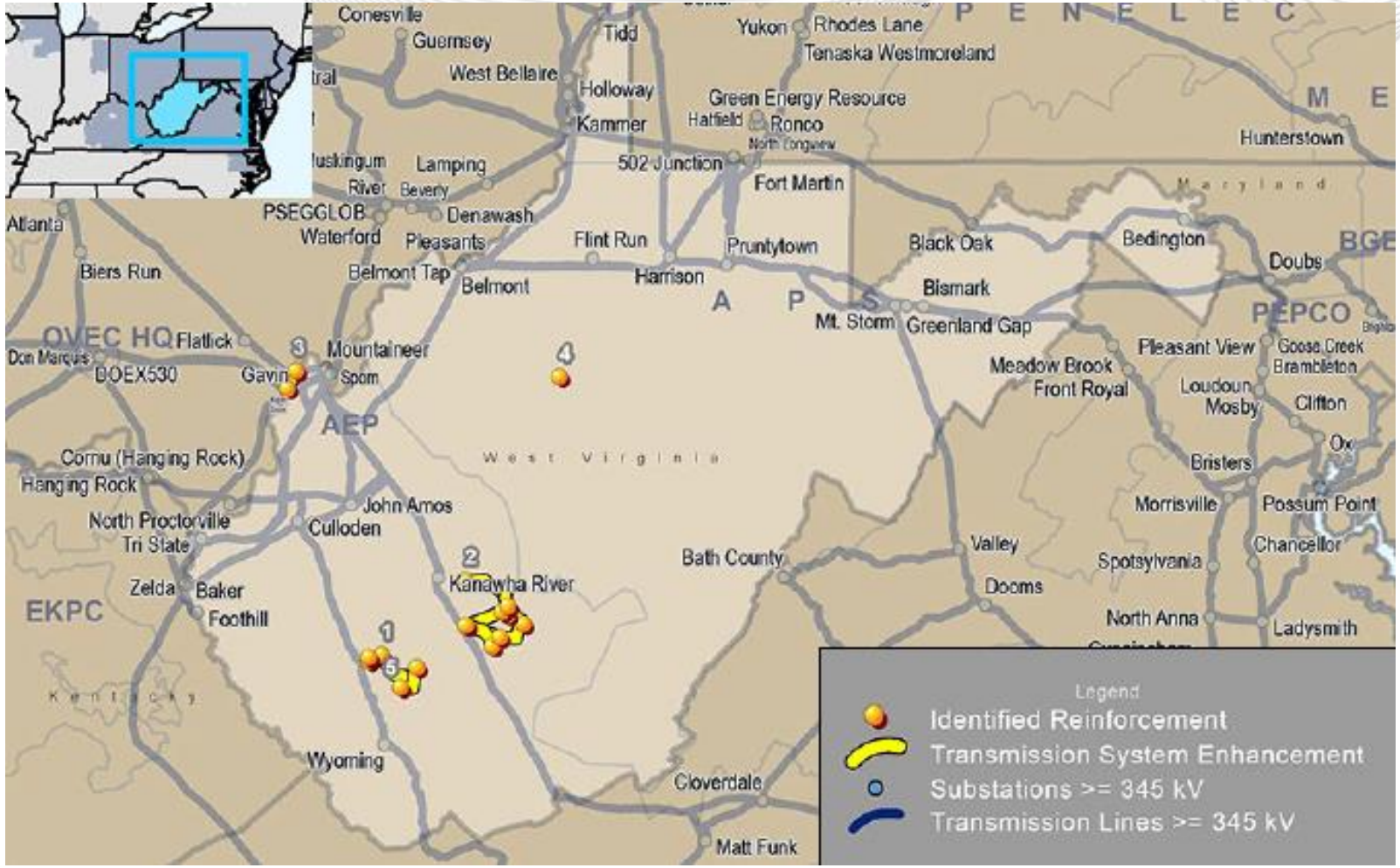
Map ID	Project	Description	Required In-Service Date	Project Cost ($M)	TO Zone	TEAC Date
7	b3282.1	Install a second 138 kV circuit utilizing 795 ACSR conductor on the open position of the existing double-circuit towers from East Huntington-North Proctorville. Remove the existing 34.5 kV line from East Huntington-North Chesapeake, and rebuild this section to 138 kV served from a new phase-over-phase switch off the new East Huntington-North Proctorville 138 kV No. 2 line.	6/1/2025	$10.40	AEP	2/17/2021
	b3282.2	Install a 138 kV, 40 kA circuit breaker at North Proctorville.				
	b3282.3	Install a 138 kV, 40 kA circuit breaker at East Huntington.				
	b3282.4	Convert the existing 34/12 kV North Chesapeake to a 138/12 kV station.				
8	b3284	Rebuild ~5.44 miles of 69 kV line from Lock Lane to Point Pleasant.		$13.50		1/15/2021
9	b3287	Upgrade 69 kV risers at Moundsville station toward George Washington.		$0.05		
10	b3347.1	Rebuild ~20 miles of line between Bancroft and Milton stations with 556 ACSR conductor.	11/1/2026	$56.73		11/2/2021
	b3347.2	Replace the jumpers around Hurrican switch with 556 ACSR.				
	b3347.3	Replace the jumpers around Teays switch with 556 ACSR.				
	b3347.4	Winfield Station relay settings – Update relay settings to coordinate with remote ends on line rebuild.				
	b3347.5	Bancroft Station relay settings – Update relay settings to coordinate with remote ends on line rebuild.				
	b3347.6	Milton Station relay settings – Update relay settings to coordinate with remote ends on line rebuild.				
	b3347.7	Putnam Village station relay settings – Update relay settings to coordinate with remote ends on line rebuild.				

West Virginia – RTEP Network Projects

West Virginia had no network project upgrades in 2021.

Note: Network upgrades are new or upgraded facilities required primarily to eliminate reliability criteria violations caused by proposed generation, merchant transmission or long term firm transmission service requests, as well as certain direct connection facilities required to interconnect proposed generation projects.

West Virginia – TO Supplemental Projects



Note: Supplemental projects are transmission expansions or enhancements that are not required for compliance with PJM criteria and are not state public policy projects according to the PJM Operating Agreement. These projects are used as inputs to RTEP models, but are not required for reliability, economic efficiency or operational performance criteria, as determined by PJM.

West Virginia – TO Supplemental Projects

Map ID	Project	Description	Projected In-Service Date	Project Cost ($M)	TO Zone	TEAC Date
1	s2406	Replace existing 138/69/46 kV, 75 MVA transformer at Bim station with a new 138/69/46 kV, 130 MVA XFR. Replace existing 138 kV ground switch MOAB with a new 138 kV circuit switcher. Replace existing 69 kV circuit breaker D with a new 69 kV, 3000A 40 kA breaker. Replace existing 69 kV shunt cap switcher BB with a new 69 kV, 40 kA cap switcher. Replace existing 46 kV circuit breakers A, B, C and E with four new 46 kV, 3000A 40 kA breakers in a ring configuration. Retire existing 46 kV, 14.4 MVAR cap bank. New DICM will be installed. The new equipment at Bim will result in a ratings increase on the Bim-Bandy branch (Sundial) line section SN/SE/WE/WN: 84 MVA/84 MVA/106 MVA/106 MVA. Remote end work required at Sharples, Skin Fork and Sundial. Line work required on entrance spans due to the new station layout. Currently the 69 kV bus is located on top of the 46 kV bus. In order to perform the work necessary, the two buses will be separated and built in the clear.	6/1/2022	$14.90	AEP	10/16/2020
2	s2430.1	Construct ~9.6 miles of new 69 kV line from Kincaid station to the new Whitewater	9/1/2023	$72.00	AEP	11/20/2020
	s2430.2	Construct ~3.9 miles of new 69 kV line from Whitewater station to Fayetteville 69 kV station.				
	s2430.3	Construct ~1.5 miles of new 69 kV double-circuit line from the Carbondale-Tower 117 69 kV				
	s2430.4	Retire the Kincaid-Scarbro 46 kV/Kincaid-Oak Hill 69 kV double-circuit line to a point just				
	s2430.5	Reconfigure a line section between Tower 117-Carbondale to connect in the new Chestnutburg station.				
	s2430.6	Whitewater station – Establish 69 kV bus and install two new 69 kV, 3000A 40 kA circuit breakers to serve requested distribution delivery point.				
	s2430.7	Victor station – Retire/remove Gauley Mountain 69 kV station. Establish a 69 kV bus and				
	s2430.8	Fayetteville station – Install a new 69 kV three-way phase-over-phase switch outside of the				

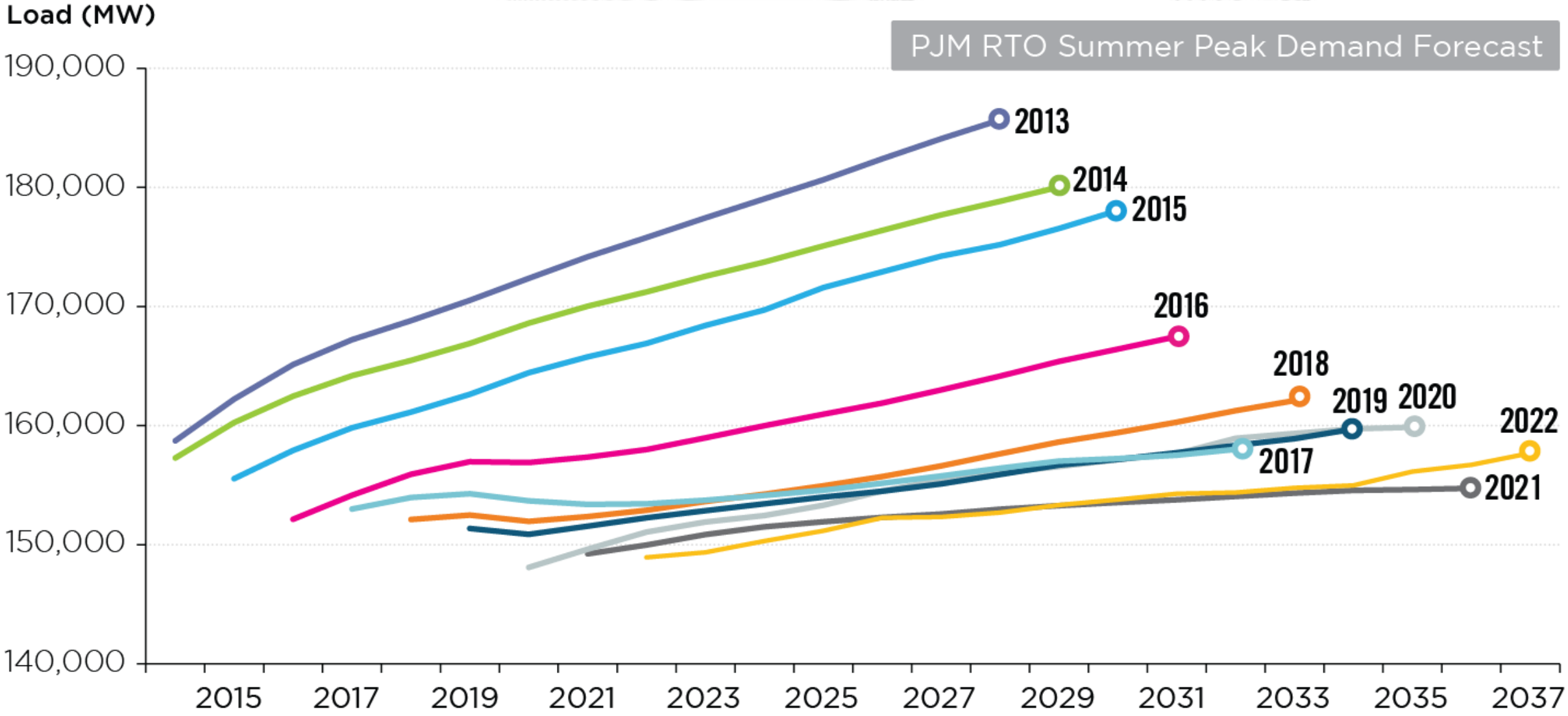
West Virginia – TO Supplemental Projects

Map ID	Project	Description	Projected In-Service Date	Project Cost ($M)	TO Zone	TEAC Date
2	s2430.9	Chestnutburg substation – Construct a new three-breaker ring utilizing three new 69 kV, 3000A 40 kA circuit breakers to eliminate a three-terminal line connection.	9/1/2023	(Continued)	AEP	11/20/2020
	s2430.10	Scarbro station – Establish a 69 kV bus and install a new 69/46 kV, 50 MVA transformer and a new 69 kV, 3000A 40 kA circuit breaker to tie in Tower 117 69 kV line exit.				
	s2430.11	Perform remote end work at Tower 117 station.				
	s2430.12	Perform remote end work at Carbondale station.				
3	s2522.1	Rebuild the existing 5.36 mile Lakin-Lock Lane 69 kV line.	10/31/2025	$14.00	AEP	5/21/2021
	s2522.2	Point Pleasant station – Replace existing 69 kV circuit breakers G and H with two new 69 kV, 3000A 40 kA circuit breakers. Replace existing cap switcher AA with a new 69 kV cap switcher.				
4	s2543	At Glenville substation – Extend the 138 kV bus. Install 26.4 MVAR, 138 kV capacitor. Install 138 kV capacitor switcher.	6/1/2021	$1.30	APS	4/16/2021
5	s2573.1	Remove the equipment at Spruce Laurel station.	5/1/2022	$0.45	AEP	7/15/2021
	s2573.2	Remove the equipment at Hampton station.				
	s2573.3	One Transmission line structure at Hampton station will be removed and new guy wires will be added to an existing structure.				

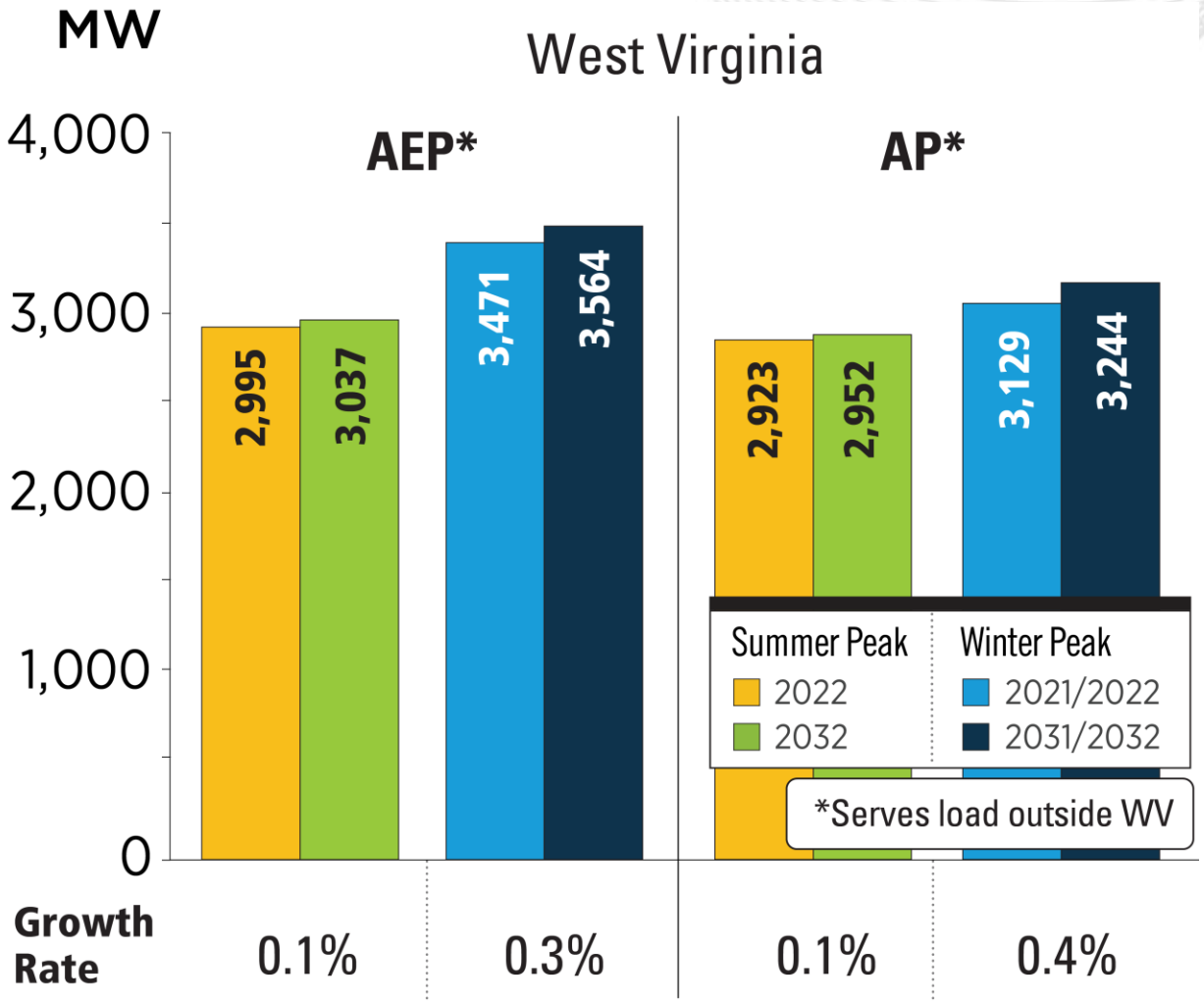
Planning
Load Forecast

PJM Annual Load Forecasts

(Jan. 2022)



West Virginia – 2022 Load Forecast Report



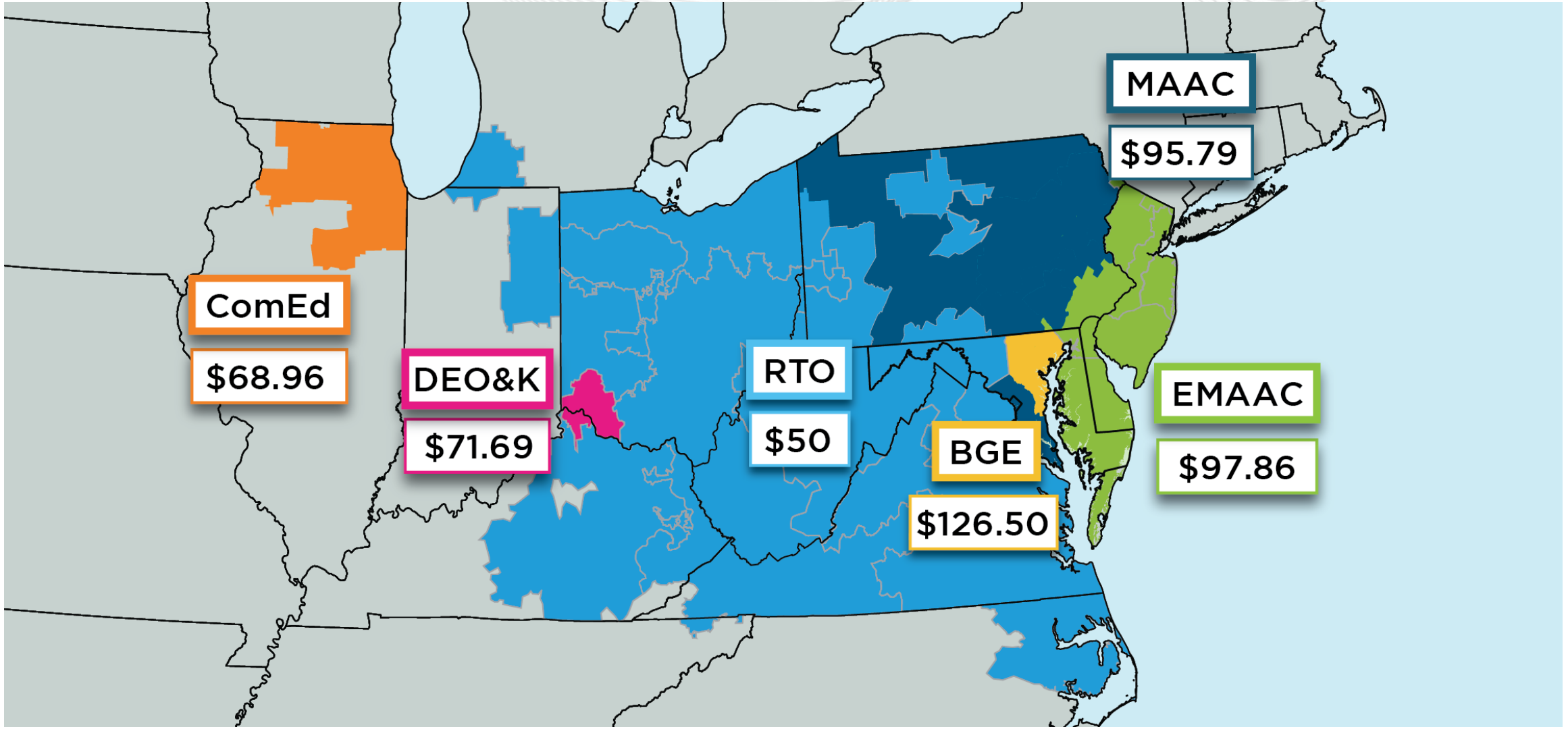
PJM RTO Summer Peak		PJM RTO Winter Peak	
2022	2032	2021/2022	2031/2032
149,938 MW	154,381 MW	132,102 MW	141,516 MW
Growth Rate 0.4%		Growth Rate 0.7%	

The summer and winter peak megawatt values reflect the estimated amount of forecasted load to be served by each transmission owner in the noted state/district. Estimated amounts were calculated based on the average share of each transmission owner's real-time summer and winter peak load in those areas over the past five years.

Markets

Capacity Market Results

2022/2023 Base Residual Auction Clearing Prices ($/MW-Day)



PJM – 2022/2023 Cleared MW (UCAP) by Resource Type

	ANNUAL	SUMMER	WINTER	Total (MW)
Generation	130,844.9	9.9	686.8	131,541.6
DR	8,369.9	442.0	0.0	8,811.9
EE	4,575.7	234.9	0.0	4,810.6
Total (MW)	143,790.5	686.8	686.8	

West Virginia – Cleared Resources in 2022/23 Auction

(June 2, 2021)

	Cleared MW (Unforced Capacity)	Change from 2021/22 Auction
Generation	5,662	+1,608
Demand Response	403	-164
Energy Efficiency	144	+101
Total	6,209	+1,545

RTO Locational Clearing Price
$50

NOTE: Demand Response and Energy Efficiency are reported to PJM by Transmission Zone. The numbers above reflect the state's pro-rata share of cross-state zones for illustrative purposes.

West Virginia – Offered and Cleared Resources in 2022/23 Auction

(June 2, 2021)

		Unforced Capacity
Generation	Offered MW	5,869
	Cleared MW	5,662
Demand Response	Offered MW	519
	Cleared MW	403
Energy Efficiency	Offered MW	152
	Cleared MW	144
Total Offered MW		6,540
Total Cleared MW		6,209

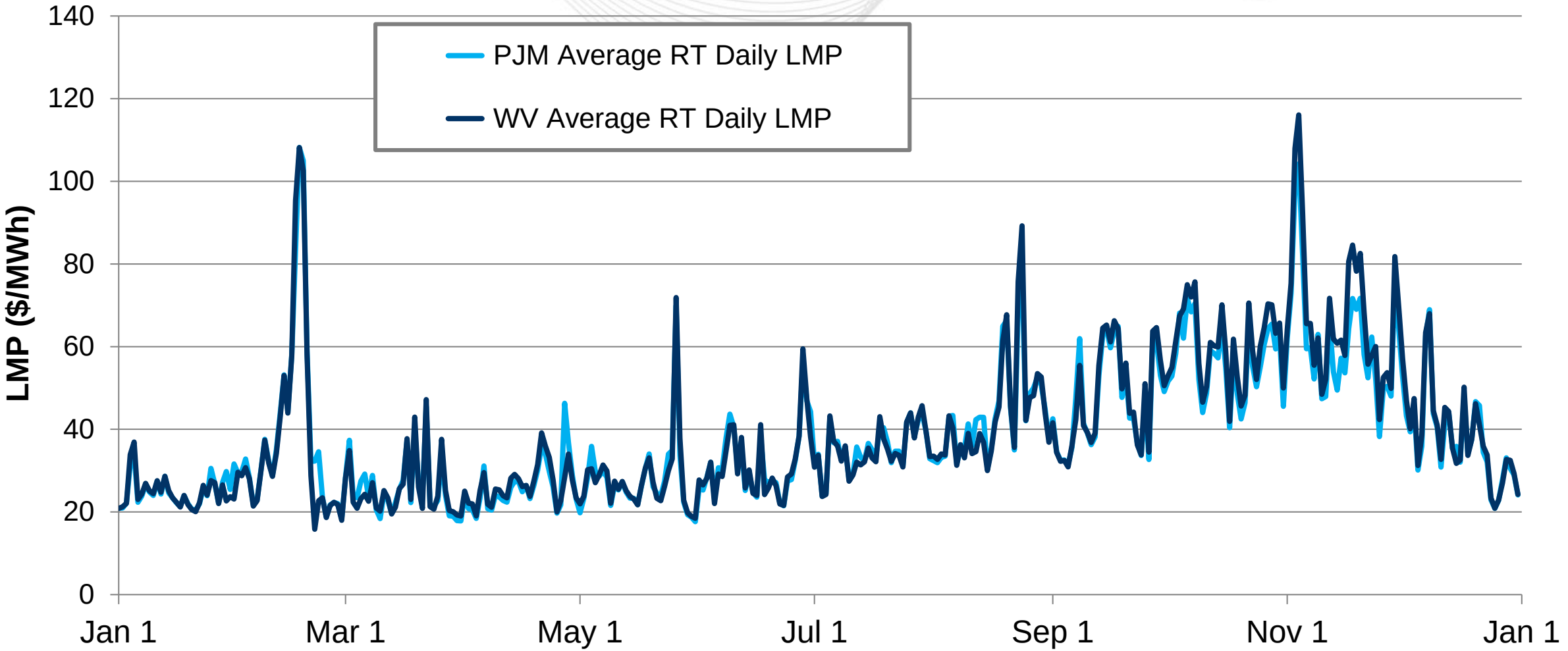
NOTE: Demand Response and Energy Efficiency are reported to PJM by Transmission Zone. The numbers above reflect the state's pro-rata share of cross-state zones for illustrative purposes.

Markets

Market Analysis

West Virginia – Average Daily LMP

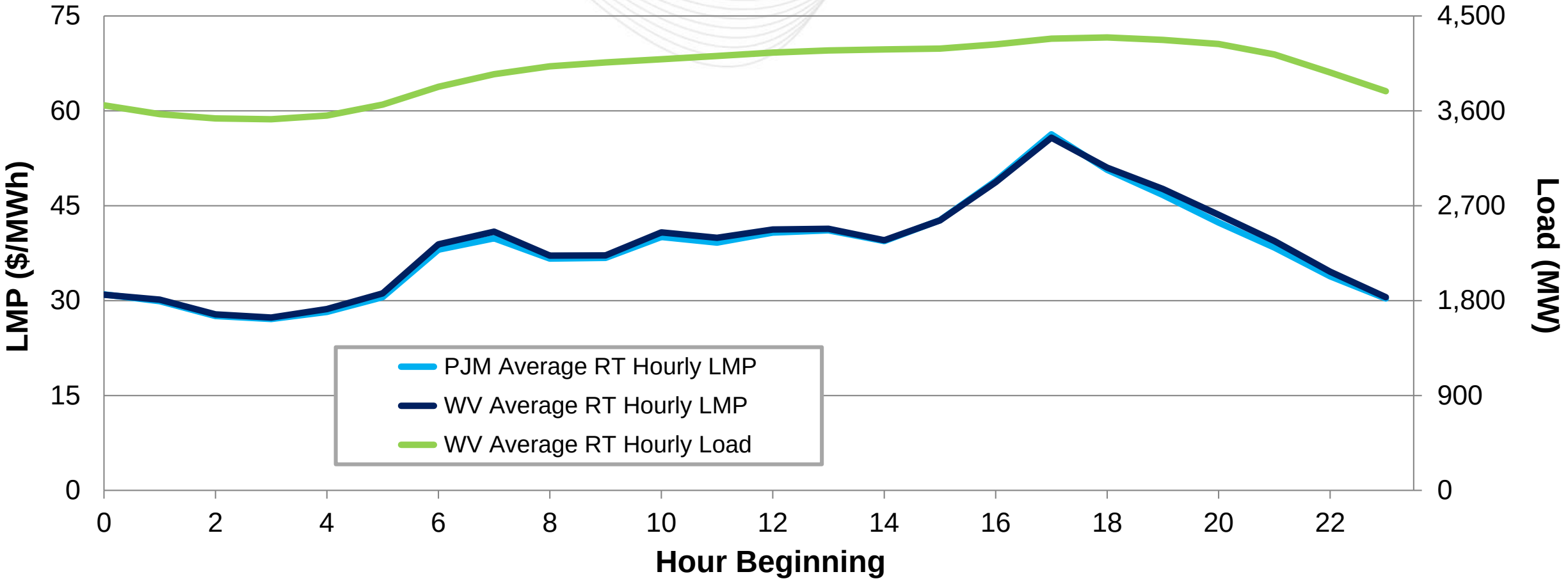
(Jan. 1, 2021 – Dec. 31, 2021)



West Virginia – Average Hourly LMP and Load

(Jan. 1, 2021 – Dec. 31, 2021)

West Virginia's average hourly LMPs aligned with the PJM average hourly LMP.



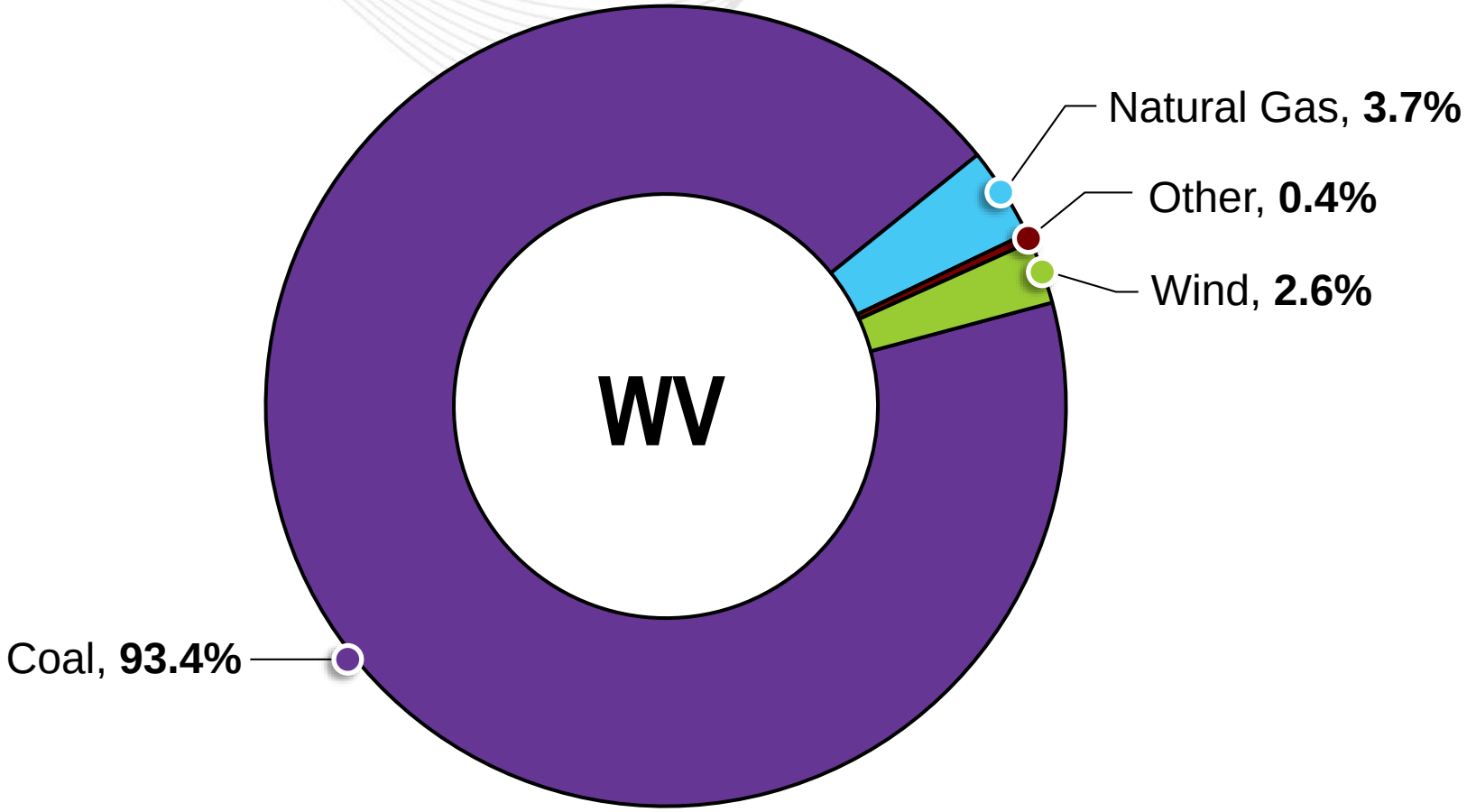
West Virginia – Net Energy Import/Export Trend

(Jan. 2021 – Dec. 2021)

Positive values represent exports and negative values represent imports.

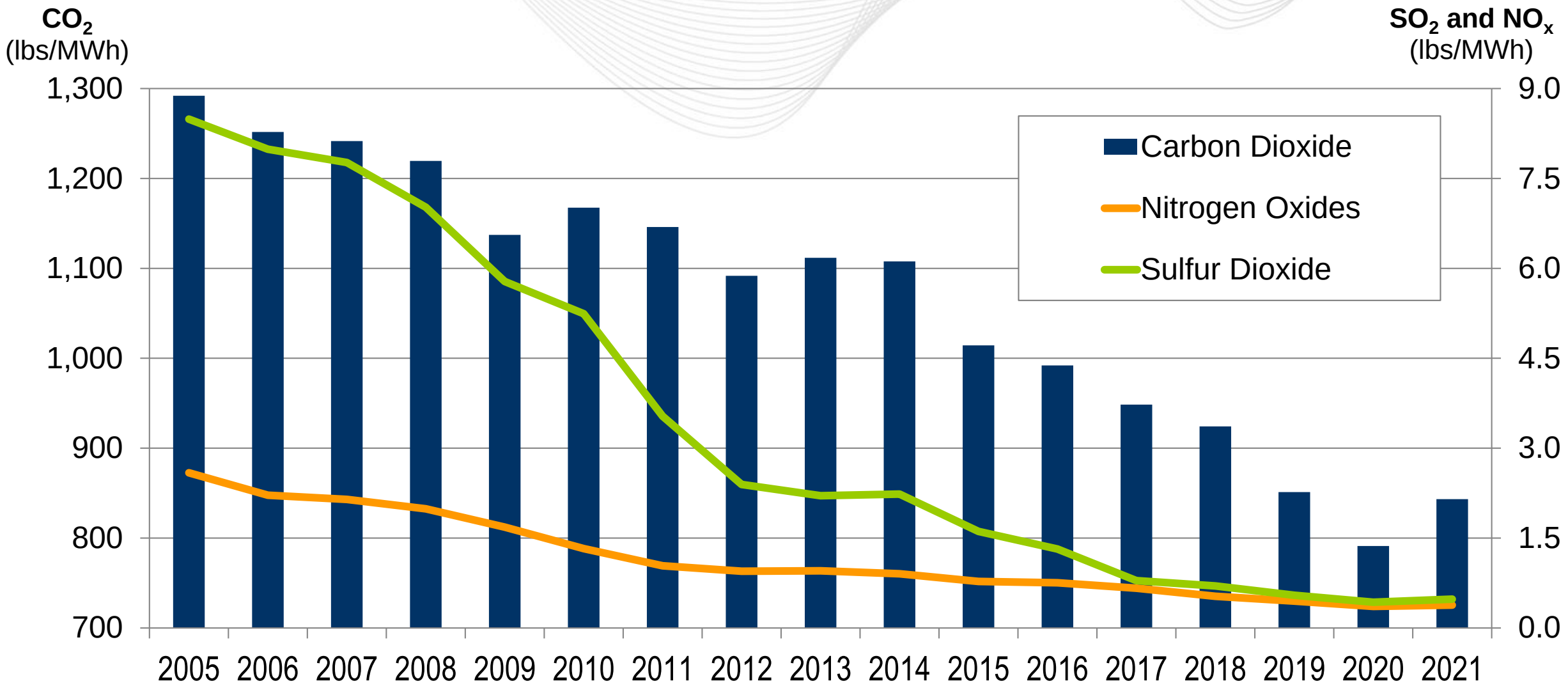
Operations

West Virginia – 2021 Generator Production



The data in this chart comes from EIA Form 923 (2021).

2005 – 2021 PJM Average Emissions



West Virginia – Average Emissions (lbs/MWh)

(Feb. 2022)